

1 1. A method for the simultaneous determination of a sample thickness L
2 and index of refraction n , the method comprising:

3 a) forming said sample with a first and a second surfaces;

4 b) forming a radiation beam and impinging said radiation beam onto said sample
5 at a first incidence angle A_1 relative to an axis perpendicular to said first surface;

6 c) reflecting said impinged radiation beam from said first and said second
7 surfaces of said sample forming a first and a second reflected radiation beams;

8 d) impinging said first and second reflected radiation beams on a detection
9 device;

10 e) measuring a distance d_1 on said array between an impingement point of said
11 first reflected beam and an impingement point of said second reflected radiation beam;

12 f) altering said first incidence angle to a second incidence angle A_2 and again
13 measuring a distance d_2 between an impingement point of a third reflected beam and an
14 impingement point of a fourth reflected beam on said detection device;

15 g) obtaining the sample thickness L and sample index of refraction n from the
16 following equations:

17 $d_1 = [2.L/n].[\sin A_1 / (1 - (\sin^2 A_1)/n^2)^{1/2}]$ and

18 $d_2 = [2.L/n].[\sin A_2 / (1 - (\sin^2 A_2)/n^2)^{1/2}]$

1 2. A method for the simultaneous determination of a sample thickness L
2 and index of refraction n , the method comprising reflecting a radiation beam at a first
3 incidence angle A_1 onto a sample having a first and a second parallel reflective surfaces
4 and projecting a first surface reflected radiation beam and a second surface reflected

5 radiation beam onto a detection device, determining a distance d_1 between said
6 projected reflection beams onto said detection device, altering said incidence angle to a
7 second incidence angle A_2 and measuring a second distance d_2 between said projected
8 reflection beams onto said detection device, and solving the following system of
9 equations:

10
$$d_1 = [2 \cdot L/n] \cdot [\sin A_1 / (1 - (\sin^2 A_1)/n^2)^{1/2}] \text{ and}$$

11
$$d_2 = [2 \cdot L/n] \cdot [\sin A_2 / (1 - (\sin^2 A_2)/n^2)^{1/2}]$$

12 to obtain values for L and n .

1 3. A method for the simultaneous determination of a sample thickness L
2 and index of refraction n , the method comprising:

3 a) directing along an axis forming a first angle A_1 with said sample a radiation
4 beam, transmitting said radiation beam through said sample, intercepting said
5 transmitted radiation beam by a detection device and measuring a distance d_1 between a
6 point on said detection device where said axis intercepts said detection device and a
7 point on said detection device where said transmitted beam impinges on said detection
8 device; and

9 b) directing said radiation beam along a second axis forming a second angle A_2
10 with said sample, again transmitting said radiation beam through said sample and
11 measuring a second distance d_2 between a point on said detection device where said
12 second axis intercepts said detection device and a point on said detection device where
13 said again transmitted beam impinges on said detection device; and

14 c) solving the following system of equations:

15
$$d_1 = L [\sin A_1 - (\sin 2A_1 \div 2(n^2 - \sin^2 A_1)^{1/2})] \text{ and}$$

16 $d_2 = L [\sin A_2 - (\sin 2A_2 \div 2(n^2 - \sin^2 A_2)^{1/2})]$

17 to obtain values for L and n.

1 4. The method according to any one of claims 1-3 wherein the detection
2 device comprises a photo-detector.

1 5. The method according to any one of claims 1-3 wherein angle A₁ and
2 angle A₂ are both greater than 10 degrees.

1 6. The method according to any one of claims 1-3 wherein the radiation
2 beam is monochromatic.

1 7. The method according to any one of claims 1-3 wherein the radiation
2 beam is collimated.

1 8. The method according to any one of claims 1-3 wherein the radiation
2 beam is a laser beam.

1 9. The method according to any one of claims 1-3 wherein the sample is
2 transmits a portion of the radiation beam.

1 10. The method according to any one of claims 1-3 wherein the sample is a
2 liquid in a cuvette.

1 11. The method according to any one of claims 1-3 wherein the first and the
2 second surfaces of the sample are parallel.

1 12. The method according to any one of claims 1-2 wherein the radiation
2 beam is polarized and the incidence angles A₁ and A₂ both correspond to internal angles
3 smaller than a total internal reflection angle at each of said surfaces.

1 13. A method for the simultaneous determination of a sample thickness L
2 and index of refraction n , the method comprising:

3 a) directing a substantially monochromatic collimated beam of radiation onto
4 said sample along an axis forming a first angle A_x and a second angle A_y in a coordinate
5 system having said sample in a plane defined by the x and y axis of said system,
6 wherein said A_x is measured in a plane defined by the x and z axes and A_y in a plane
7 defined by the y and z axes,

8 b) transmitting said beam through said sample and impinging said transmitted
9 beam onto an array of radiation detectors arrayed in a plane parallel to said x - y plane;

10 c) measuring a first distance d_x on the x -axis between a point where said axis of
11 monochromatic collimated beam impinges on said array of radiation detectors and a
12 point where the monochromatic collimated beam impinges on said array of radiation
13 detectors,

14 d) measuring a second distance d_y on the y -axis between a point where said axis
15 of monochromatic collimated beam impinges on said array of radiation detectors and a
16 point where the monochromatic collimated beam impinges on said array of radiation
17 detectors; and

18 e) solving the following system of equations:

19
$$d_x = L [\sin A_x - (\sin 2A_x \div 2(n^2 - \sin^2 A_x)^{1/2})]$$
 and

20
$$d_y = L [\sin A_y - (\sin 2A_y \div 2(n^2 - \sin^2 A_y)^{1/2})]$$

21 to obtain values for L and n .

1 14. A method for the simultaneous determination of a sample thickness **L**
2 and index of refraction **n**, the sample having substantially parallel first and second
3 surfaces lying in an x-y plane of a Cartesian co-ordinate system having x, y and z axes,
4 the two surfaces separated by said distance **L** measured along the z axis, the method
5 comprising:

6 a) directing an incident radiation beam of substantially collimated
7 monochromatic radiation onto said sample, said radiation beam forming an angle **A_x** in
8 the x-z plane and an angle **A_y** in the y-z plane relative to the z axis;

9 b) reflecting said incident radiation off said first and said second surfaces;

10 c) intercepting said reflected incident radiation from said first and second
11 surfaces with an array of radiation sensors and determining a first distance **dx** and a
12 second distance **dy** between a point of incidence on said array of radiation sensors of
13 said radiation beam reflected from said first surface and a point of incidence of said
14 radiation beam reflected off said second surface measured along said x axis and said y
15 axis respectively; and

16 d) solving the following equations simultaneously for said thickness **L** and said
17 index of refraction **n**:

18
$$d_x = [2 \cdot L/n] \cdot [\sin A_x / (1 - (\sin^2 A_x)/n^2)^{1/2}] \text{ and}$$

19
$$d_y = [2 \cdot L/n] \cdot [\sin A_y / (1 - (\sin^2 A_y)/n^2)^{1/2}]$$

1 15. The method according to claims 13 or 14 wherein said array of radiation
2 sensors is a single two dimensional CCD sensor or an array of CCD sensors.

1 16. The method according to claims 13 or 14 wherein said array of radiation
2 sensors is connected with a computer and said computer is programmed to measure the
3 distances d_1 , d_2 , d_x or d_y on said array of radiation sensors.

1 17. The method according to claim 16 wherein said computer is also
2 programmed to solve said equations for L and n .

1 18. A system for the simultaneous determination of a sample thickness L and
2 index of refraction n , the sample having substantially parallel first and second
3 surfaces, comprising:

4 a) a radiation beam along a path;

5 b) a holder adapted to hold said sample in said beam path at an adjustable angle
6 relative to said sample surfaces;

7 c) a radiation detector placed to receive said radiation beam after said beam has
8 impinged on said sample;

9 d) measuring means for measuring a distance between a reference point on said
10 radiation detector and a point of impingement of said beam on said radiation detector

11 e) means for outputting an output indicative of said measured distance.

1 19. The system of claim 18 wherein the radiation detector comprises an
2 array of sensors.

1 20. The system of claim 18 wherein the sample is a liquid in a cuvette.